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Chair: H. Schmickler
Scientific Secretary: C. Rossi

Agenda:
Minutes approval and follow-up of the previous meeting (CR)
Minutes of the previous meeting link ?
The CLIC Module assembly: lessons learnt and outlook for the next design phase. (SD)
S. Doebert's presentation
AOB: Date and goals for next meeting

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1. Approval of minutes and follow-up of the previous meeting

C. Rossi requests a clarification concerning the minutes of the previous meeting, on the point regarding the granularity required by the beam optics and the implications for the AS fabrication. **D. Schulte:** points out that the granularity required in the low energy part of the Main Linac mainly concerns the Drive Beam more than the Main Beam, so in principle 2-m-long AS would not be a problem provided that the drive beam optics is preserved. About the real possibility to build any AS length, N. Catalan commented after the meeting that this can only happen in multiples of 50 cm since powered by one PETS .

2. The CLIC Module assembly: lessons learnt and outlook for the next design phase.

S. Doebert: shows a list of possible changes and improvements of the module architecture descending from the experience gained with the CLEX installation and that could go into the next phase module. A critical item compendium is being filled and maintained by M. Aicheler.
The present design was based on the possibility to achieve the tight tolerances imposed by the Beam Dynamics and by the alignment needs. **S. Doebert** comments that the required tolerance in AS fabrication has not been achieved so far; it has been observed that any attempt to fix the AS to the supports creates a deformation, being the AS made of soft copper. The need for longitudinal adjustment was also not adequately considered in the design. The results that have been reported from PACMAN encourage to chose a solution that is rather based on the adjustability of the different elements on the main girder; however the limits of the option with fixed supports do not seem to have been completely explored.
Several reasons suggest to go for adjustment, but they are mainly related to the less need for high tolerance girder and transport.
The PETS are missing any alignment features, which should be implemented whatever option is chosen. Also it has been observed that choke mode flanges are not providing the required decoupling between the Main and the Drive Beam girders but they could probably be improved with further design work.
W. Wuensch stresses that the basic RF unit would be 1 PETS and 1 SAS, if flanges were missing in the previous design they can certainly be implemented; what really matter is that the unit should not be disassembled after the initial conditioning.
The most relevant point for AS straightness concerns the WFM position with respect to beam axis and this is certainly independent of the alignment strategy that is adopted.
The list of improvements considers also the vacuum system, the relative phasing of the AS, the connection between the BPM and the quads, which is crucial and needs to find a proper

solution, and the study of an adequate integration of the cooling distribution into the module design, so to avoid the complicate piping.
There is common agreement that the present girder design is not practical, because WPS reference to girder is easily lost and the positioning of the articulation point is critical and not easy to achieve. Future designs should integrate the WPS support and the girder.
Uniformity of the ambient temperature along the linac is generally perceived as important; however **W. Wuensch and D. Schulte** both agree on the fact that numbers should be specified, since the level of uniformity can have a strong impact on cost.
S. Doebert points out that if the area that is close to point of support of the structure to be aligned is generally better cooled the general alignment will be less affected by temperature variations. He expresses a personal preference for long supports, as long as the alignment can handle, in order to reduce the number of movers and sensors, but numerical criteria should be provided in order to allow for a decision about the “right” length.
Replying to S. Doebert’s question if the DB quads require continuous adjustability **D. Schulte** confirmed.
In fact dipole correctors could also provide the necessary correction, however they are limited in following the tunnel movement. The option to have a common support for several DB quads can be an attractive one, but it requires adjustability anyway, so motorized movers have to be foreseen. **M. Modena** comments that in any case, even if correctors could make the job, the issue remains the longitudinal space required for the correctors, which is not available. The same is true for the input coupler for the PETS, at least in the 3 TeV design.
H. Mainaud-Durand wants to point out that the initial alignment of the module can be envisaged in the tunnel, however the prealignment of the module components in accordance with the PACMAN strategy can only happen outside.
If one decides to adopt longer girder with respect to the present configuration, he should not ignore that MB quads are every 2 m, then a cut-out in the girder would be necessary to leave the space for the quadrupoles.
A discussion then starts about the possibility that industry could be asked to assemble complete modules or if it has rather to provide just the basic components; S. Doebert manifests a preference for the second option justifying it with the need to encourage the maximum competition among suppliers to obtain the best offers and also by the difficulty to maintain a convenient alignment of components during a long transportation.
W. Wuensch comments reminding the audience that we have the significant exemple of the PSI undulators where the precise alignment at the level of microns is preserved over the whole transport from industry to tunnel.
D. Schulte then asks if one can provide criteria that can allow to optimize the girder length, also defining the priorities among those criteria. H. Schmickler states that we need to quantify those elements that could allow for a final decision.
S. Doebert continues his presentation by underlining that the machine sectorization need also be reconsidered with some solid arguments, since the filling factor should not be the only parameter in the evaluation.
He supports the idea that the conditioning of RF units should be performed on modules, before the pre-alignment phase, in a dedicated klystron facility. This does not agree with the strategy proposed by the X-band structure team, which envisages a conditioning and acceptance test at the supplier premises (to be confirmed).
S. Doebert insists on the fact that the number of connections between the different parts should be minimized.
W. Wuensch reminds the audience that a stiff common support for the soft copper structures was the initial idea to provide the required rigidity to the preassembled RF structures. The material by which that support should be made of is then discussed, since in someone view it should be made of SiC, to be insensitive to temperature variations, and for others it should

rather be made of copper, in order to have the same expansion coefficient of AS. **M. Modena** comments that elements of different mass will anyway move with respect to each other.

Discussing S. Doebert's idea that the module alignment should be performed in situ, since our experience with CLEX and Lab modules is that the alignment is lost after even a small transport, **D. Schulte, W. Wuensch and H. Schmickler** are rather convinced that alignment in situ would be very difficult, especially if one considers that the replacement of one module during operation should remain possible within the time allowed by a machine stop. **H. Mainaud-Durand** confirms that a simple check in situ would be much easier, once the module has been initially aligned on surface.

On the other hand **R. Corsini** stresses that the installation will not be performed sequentially in any case but several modules will be installed in parallel, so the issue of installing a module in between modules that are already in place must be evaluated and solved.

D. Schulte underlines that the elements that really require alignment are the BPMs, on which the whole beam based alignment strategy is based.

The dynamic alignment of single elements is then discussed, which could consistently relax the initial alignment requirements.

W. Wuensch comments that a dynamic alignment prerequisite would be to establish which maximum length of rigid components is acceptable to make this dynamic alignement work. **S. Doebert** remarks that the cost model could help to make a decision on the strategy to be followed (girder length, alignment strategy, dynamic alignment).

D. Schulte then asks if one could imagine to move also AS, which would be a really attractive option. **H. Mainaud-Durand** comments that the present scheme already foresees movers that are expected to work with motors that are plugged and unplugged during the alignment phase. This may become a permanent installation.

W. Wuensch reminds the audience that initially the girder was meant to define the stiffness of the structures.

3. Conclusions.

H. Schmickler conclude that beam dynamics should provide some input to make decision about the option of having a single girder. The module team can proceed and analyse the implications of the single girder, which could eventually be validated by the beam dynamics later on. Elements should be provided in 3 – 4 months to make a decision about the direction the study should proceed further. **M. Modena** warns that collective movement of DB quads can jeopardise the optics, if now they become independent of the girder then individual movers are required.